August 1973
Updated August 1974

UPDATED COPY

B73-10305

NASA TECH BRIEF

Lyndon B. Johnson Space Center

Dynamic Power Load Simulator

The problem:

The optimal design of electrical power distribution and conditioning systems depends upon the characteristics of the power sources and the loads. In many cases, it is important to evaluate system performance under true load conditions. However, present electrical power load simulators can reproduce only steady-state conditions. The full-scale dynamic, or transient, electrical-load power profile cannot be accurately simulated. For this reason, low voltages, effects on other loads, and other potential problems arising from inadequate dynamic load design cannot be evaluated.

The solution:

Two different and independent models have been developed to simulate the dynamic and steady-state responses of electrical and electronic equipment under a power load. One is a resistance/capacitance/inductance network, and the other is a variable resistance analog device. Resistance, inductance, and/or capacitance are selected by an iterative process; the time-domain response is compared, by a computer program, with that of the real equipment to select optimal values.

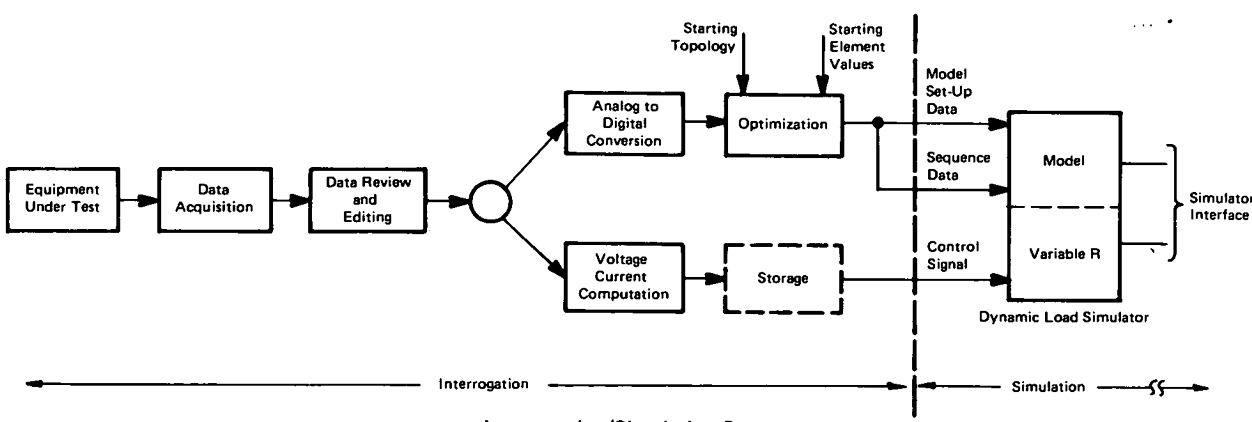
How it's done:

Both devices are part of an overall test system shown in the block diagram. Equipment successfully tested includes switches, inverters, transceivers, and beacons. The test procedure is divided into two phases: an equipment interrogation phase and a simulation phase. The interrogation phase comprises the quantitative determination of parameters that describe the dynamic and steady-state electrical response of the power lines to specified voltages. The simulation phase is the duplication, on the power lines, of the dynamic and steady-state response of an electrical load.

The interrogation phase begins with data acquisition, which is the same for both simulators. The operating voltage is applied to the equipment, and voltage and current versus time are recorded. The power source, shunts, wiring, and the necessary interface equipment are included in this process.

The voltage and current characteristics are then analog recorded on tape. An editing capability allows the quality of the recorded data to be quickly reviewed.

For the network simulator, the data is converted to digital form and computerized. From an initial estimate,



Interrogation/Simulation System

(continued overleaf)

the computer iteratively selects the optimal resistor, inductor, capacitor, and time-delay values to match the real equipment. The appropriate values are manually set in the simulator.

The model network simulator is a three-branch electrical network of discretely variable resistors, capacitors, and inductors. For the simulation of discontinuous or complex waveforms, the branches may be introduced or removed at specified times during the test.

The variable resistance simulation requires that the analog data be processed somewhat differently. A resistance network divides the voltage data by the current data to give a resistance equivalent. This information goes to a tape storage and is played back as the input voltage control for the variable resistance simulator. Several dynamic simulations may be run in parallel or in series. The output resistance of the simulator is connected to the power source which operates the real equipment. Thus the power input current is made to vary just as the input current to the real equipment.

Both models are capable of simulating loads with the following power characteristics, but the variable-resistance simulator is limited to positive, non-zero-crossing voltages:

Voltage: (a) 100 to 130 V, 60 to 400 Hz, single phase
(b) 20 VDC to ground
Current: Up to 8 A
Power: Up to 250 W

Note:

The following documentation may be obtained from:
National Technical Information Service
Springfield, Virginia 22151
Single document price $14.00
(or microfiche $0.95)

Reference: NASA CR-115760 (N72-30248)
Dynamic Load Simulator, Final Report.

Patent status:

NASA has decided not to apply for a patent.

Source: K. D. Castle of
Johnson Space Center and
M. Weinberger, C. Russell, Jr., K. P. Joncas,
S. Birnbach, and M. Lambert III of
Avco Corp.
under contract to
Johnson Space Center
(MSC-14285, 14286)